Out of Position - Possibilities and Limitations of Numerical Simulation

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Gas jet model

Multi-Chamber airbag

Meshless methods for gas dynamic models

Methodology

Test Device

Know How

Data and parameter of airbag module

Inflator data - Fabric - Folding - Cover

Forecast

Evaluation

Input

Results

Forecast

History
Alternative method for calculation of mass flow

Input data

Alternative method for calculation of mass flow

Input data
Comparison of airbag foldings without and with super-positioned shells

Input data

Picture Frame Test

Biaxial Fabric Test

Drape Fabric Test

State of the Art

Input data

for folding simulation according DIN 54906

Proposed test to determine bending stiffness of airbag fabric

Membrane elements with super-positioned shells

Folding with

Membrane elements

Input data
Airbag with three pre-foldings
• Tacked and tear seams
• Folding sliders with placeholder and diffuser
• SIM-Folder© folding software

Simulation PETRI folded airbag

Input data
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Section cut through module by Micro Computer Tomography (MCT)

Compressive stiffness of Membrane Elements

Input data
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* Dummy Version 6.1

CAE V6.1

TEST

Dummy A

TEST

Dummy B

Results

Prediction vs. Test – Position 1

Prediction vs. Test – Position 2
Main injury mechanisms of OoP situations can be predicted by numerical simulation. However, peak values are too high generally.

The characteristics of occupant load curves are proper but peak values are too high generally.

Influences of airbag folding, cover design, and inflator performance can be evaluated by numerical simulation (currently driver's side only).

Improved quality of dummy models;

Right assumptions for contact interactions;

Reduced answering time of numerical simulation (modeling and calculation time);

Same models for in- and out-of-position simulations;

Further studies for in- and out-of-position simulations;

Improved quality of dummy models.